

High Thrust Efficiency MPD Thruster, Phase I

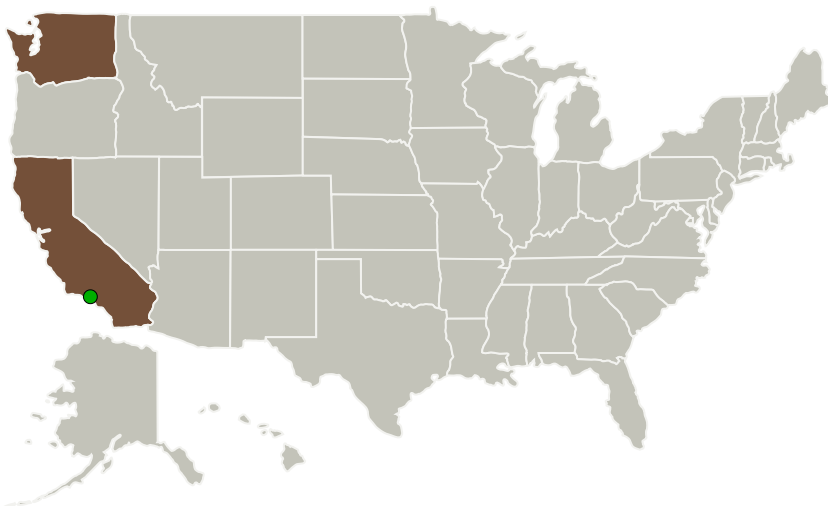
Completed Technology Project (2011 - 2011)



Project Introduction

Magnetoplasmadynamic (MPD) thrusters can provide the high-specific impulse, high-power propulsion required to support human and robotic exploration missions to the asteroids, Moon, Mars, and the outer planets. MPD thrusters, however, have traditionally been plagued by poor thrust efficiencies due primarily to power lost into the anode caused by the Hall effect. We propose to combine three innovative techniques to create a high thrust efficiency MPD thruster. The first is an unconventional applied magnetic field geometry that counter the Hall effect near the anode surface, the second is shaping of the electrodes to optimize current uniformity, and the third is "through-anode" propellant injection to prevent depletion of the anode plasma. In prior experiments we demonstrated elimination of the anode fall using these novel magnetic fields, and in recent simulation efforts we developed novel magnetic nozzle designs that succeed in counteracting the current concentrations and plasma starvation effects that cause the anode fall. These magnetic nozzles also showed the ability to increase the amount of axial thrust extracted from the accelerated plasma by over 50%. In the Phase I, we will test the effect of a prototype 'optimized' magnetic nozzle on the thrust efficiency of a MPD thruster; both the magnetic nozzle prototype and thruster test article are already constructed. Additionally, we will develop technology for through-anode propellant injection, and evaluate its performance through tests and simulations.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
Tethers Unlimited Inc	Lead Organization	Industry	
● Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations	
California	Washington

Project Transitions

**February 2011:** Project Start**September 2011:** Closed out**Closeout Documentation:**

- Final Summary Chart(<https://techport.nasa.gov/file/138227>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Tethers Unlimited Inc

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

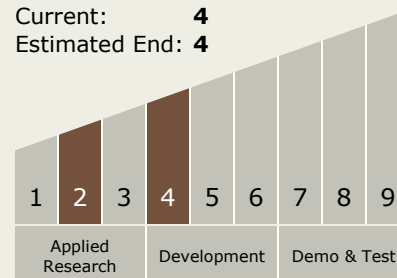
Robert P Hoyt

Technology Maturity (TRL)

Start: 2

Current: 4

Estimated End: 4



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Technology Areas

Primary:

- TX01 Propulsion Systems
 - └ TX01.2 Electric Space Propulsion
 - └ TX01.2.2 Electrostatic

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System